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BRUCE NGS "B", RB 7
INSPECTION OF
CONCRETE CONTAINMENT BOUNDARY

Report No 88-174-K

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ABSTRACT

An inspection of the concrete containment boundary of Reactor Building 7 (RB 7) was conducted during a planned outage in April 1988.

No significant defects were noted.

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BRUCE NGS "B", RB 7
INSPECTION OF CONCRETE CONTAINMENT BOUNDARY

1.0 INTRODUCTION

An inspection of the accessible areas of the exterior concrete containment boundary of the reactor building and fuelling machine duct, Unit 7, Bruce NGS "B", was conducted from April 25 to 28, 1988, during the unit outage. This inspection was carried out in accordance with the work plan "Bruce NGS "B" Unit #7 - Concrete Containment Structures and Containment Appurtenances Inspection Program (1988)", prepared by the Civil Design Department[1]. The observations and test results are summarized in this report.

2.0 SCOPE

2.1 Inspection Methods

The concrete at selected locations on the accessible exterior containment boundary of the reactor building and fuelling machine duct for Unit 7 was visually inspected. Cracks in the concrete were mapped and the crack widths measured. Where significant cracks were noted, the crack depth was estimated using ultrasonic methods. Additional non-destructive testing of the concrete, using an impact hammer, was conducted at various locations to obtain reference readings for future inspections.

The caulking around embedded parts and at construction joints was visually inspected for obvious deterioration or damage. The concrete surrounding embedded parts was also visually examined for obvious deterioration or damage.

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1. Civil Design Department Files 973-NK29-21121 and 973-NK29-34200

Where possible, cracks noted during this inspection were marked on the structure with a permanent marker for easier identification during future inspections.

2.2 Inspection Areas

The areas inspected are listed below:

1) All critical stress areas, as determined by the Civil Design Department, on the reactor building containment surface (Figure 1);

2) All accessible areas of the breakout panel on the north side of the reactor building;

3) The concrete around Air Locks 2 and 5 (Figure 1);

4) The concrete around the anchorages and the anchor caps for the post-tensioning system of the main girders;

5) All areas where cracks were detected during the commissioning tests;

6) The concrete around the embedded parts for the preheater enclosures;

7) The concrete around the embedded parts for the steam generator bellows;

8) The concrete around the embedded parts for the primary heat transport pumps;

9) The exterior surface of the south wall of the fuelling machine duct;

10) Joint sealant (caulking) at construction joints, expansion joints, and around airlocks and embedded parts;

11) Metallic components of the exterior of the containment boundary (penetrations, seal plates) that are accessible from the floor.

3.0 OBSERVATIONS

The observations and results of tests conducted during this inspection are summarized in Tables 1 and 2 and in Figures 2 to 17. The results reported in Table 1 are listed by item as given in Section 2.2.

4.0 CONCLUSIONS

In general, the concrete inspected is in good condition and of good quality. The significance of a crack noted on the south perimeter wall, between Lines H and K at Elevation 646', should be assessed by the Civil Design Department.

Approved by:

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TABLE 1

Bruce NGS "B" - RB 7

Inspection of Containment Boundary Concrete

LOCATION	OBSERVATIONS
1. All critical stress areas on the reactor building containment surface (Figure 1).	Elevation 615' Location 1 - No visible cracks. Location 2 - No visible cracks. Location 3 - Vertical cracks at corner of chamfers, width = .003 inches. Location 4 - No visible cracks. Location 5 - No visible cracks. Location 6 - Vertical hairline cracks (painted over since construction), width = .006 to .010 inches. Location 7 - Vertical hairline crack, width = .005 inches. Diagonal crack extending from girder to floor, width = .015 inches. Location 8 - Horizontal crack on north wall at Elevation 618.5', width = .007 inches, extends to east wall. Location 9 - East wall - not accessible. South wall - no visible cracks. Elevation 639' Location 1 - No visible cracks. Location 2 - Not accessible. Location 3 - Not accessible. Location 4 - Not accessible. Location 5 - Horizontal crack on west wall, width = .010 inches. Vertical crack approximately 6 feet from corner, width = .020 inches. Location 6 - No visible cracks. Location 7 - No visible cracks. Location 8 - North wall - not accessible. East wall - horizontal hairline crack extends to north wall, width = .015 inches. Location 9 - Horizontal hairline crack at Elevation 647' extends from east to south wall. Horizontal crack at Elevation 650' extends from east to south wall, width = .020 inches.

TABLE 1, Continued

LOCATION	OBSERVATIONS
	Elevation 663'
	Location 1 - No visible cracks. Location 2 - Horizontal hairline cracks (2) widths = .004 and .012 inches. Location 3 - No visible cracks. Location 4 - No visible cracks. Location 5 - Horizontal hairline crack on west wall, width = .015 inches. Horizontal hairline crack on north wall, width = .020 inches. Location 6 - No visible cracks. Location 7 - No visible cracks. Location 8 - Horizontal hairline crack on east wall, width = .007 inches. Horizontal hairline crack on north wall, width = .004 inches Location 9 - No visible cracks.
2. All accessible areas of the breakout panel on the north side of the reactor building.	- Cracks noted on the breakout panel are shown in Figure 2. All cracks were less than .005 inches wide. - Refer also to Figures 3 and 4.
3. Concrete around Airlocks 2 and 5 (Figure 1).	- Airlock 2 - no visible cracks - a patch measuring 12 by 8 inches is located at two o'clock. - Airlock 5 - one minor hairline crack, width <.006 inches, at one o'clock.
4. Concrete around the anchorages and the anchor caps for the post-tensioning system of the main girders.	Elevation 693' West Girder - South end - Minor hairline crack on west end of both anchorage blocks. East Girder - South end - Minor hairline crack, width = .007 inches. Refer to Figure 5. - Minor hairline crack west side of north anchorage block.

TABLE 1, Continued

LOCATION	OBSERVATIONS
	East Girder - North end - Minor hairline crack on east side of both anchorage blocks. Refer to Figure 6. West Girder - North end - Minor hairline cracks. No significant cracks were noted along the entire length of the girder as viewed from the walkway at Elevation 693'.
	Elevation 678'
	West Girder - South end - Minor hairline cracks, width <.005 inches. East Girder - South end - Minor hairline cracks on both sides of the anchorage block. East Girder - North end - Hairline crack above anchorage block. - Small hairline cracks at anchors - Leakage at greased tendon - since leakage was not extensive, the caps were not removed. Refer to Figure 7. West Girder - North end - Minor hairline cracks. - Leakage at greased tendon - not as extensive as the East Girder. No significant cracks were noted along the entire length of the girder as viewed from the walkway at Elevation 693'.
	General
	The surfaces of the girders were inspected from the reactivity deck. One hairline crack was noted at the Dywidag block on the top right hand corner at the south end of the West Girder.

TABLE 1, Continued

LOCATION		OBSERVATIONS
		Caulking was omitted on the south end of the East Girder for approximately 13 feet. No significant cracks were noted in either girder. The girders were also inspected from the boiler rooms. Cracks noted around the preheater enclosure are reported in Item 6. Some hairline cracks were also noted along the length of the girders. All cracks are < .005 inches wide. Refer to Figure 8.
5.	All areas where cracks were noted during commissioning tests.	Cracks noted during commissioning and additional cracks noted during this inspection are shown in Appendix A.
6.	Concrete around the embedded parts for the preheater enclosures.	- The location of cracks in the concrete around the preheater enclosures are shown in Figures 9 to 12. Most cracks are < .005 inches wide. For the northwest preheater enclosure, cracks ranging from .008 to .015 inches wide were noted. Typical cracks are shown in Figures 13 and 14.
7.	Concrete around the embedded parts for the steam generator bellows.	- This will be reported by the Civil Design Department.
8.	Concrete around the embedded parts for the primary heat transport pumps.	- Hairline cracks were noted (width < .002 inches) around the steam generators and primary heat transport pumps. - All Dywidag nuts adjacent to the primary heat pumps are hand tight.
9.	Exterior face of the south wall of the fuelling machine duct.	Elevation 579' - Only the south wall of the fuelling machine duct is accessible. - On Line 9 between Columns P and Q, there are 12 vertical hairline cracks. Refer to Figure 15. Estimated depth of crack by ultrasonic measurement= 10.4 inches. - On Line 9 between Columns N and P, there are 5 vertical hairline cracks. Estimated depth of crack by ultrasonic measurement = 4.8 inches. - On Line 9 between Columns M and N, there are 3 vertical and one horizontal hairline cracks. - On Line 9 between Columns A and B, two vertical cracks are present with estimated depths of 6.5 and 7.3 inches (by ultrasonics).

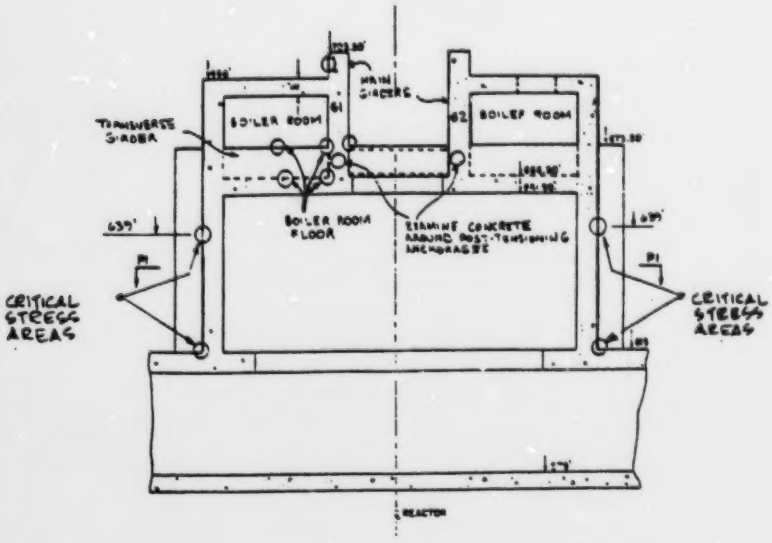
TABLE 1, Continued

LOCATION	OBSERVATIONS
	- Caulking at the joint between Units 0 and 7 is in good condition except for a split approximately 6-1/2 feet above floor level (Figure 16). - There are 6 vertical hairline cracks between Columns A and B. - On Line 9 west of Column CX, there are 3 vertical hairline cracks. Elevation 591' - Joint between Units 0 and 7 appears to be too wide (3 to 4 inches) but in good condition. - Hairline crack west of Column 7B, width = .003 inches - Horizontal hairline crack east of Column 7M, width = .007 inches. - Horizontal hairline cracks (2) at Column 7N. - Vertical hairline crack, width = .005 inches, near Column 7N - Several other fine hairline cracks marked on wall for future reference.
10. Joint sealant (caulking) at construction joints, expansion joints and around airlocks and embedded parts.	- The condition of the caulking was checked at many locations throughout the structure and was found, in all cases, to be in good condition except as noted in this report.
11. Metallic components that are accessible from the floor.	- All accessible metallic components (i.e. penetrations, seal plates, etc.) were visually inspected. No obvious defects were noted. No testing was performed on these items.
12. General condition of the concrete.	- The overall condition of the concrete was good to excellent. - A horizontal hairline crack (width = .020 inches) was noted at Elevation 646' in the south perimeter wall between Columns H and K (Figure 17). - The significance of this crack should be evaluated by the Civil Design Department.

TABLE 2

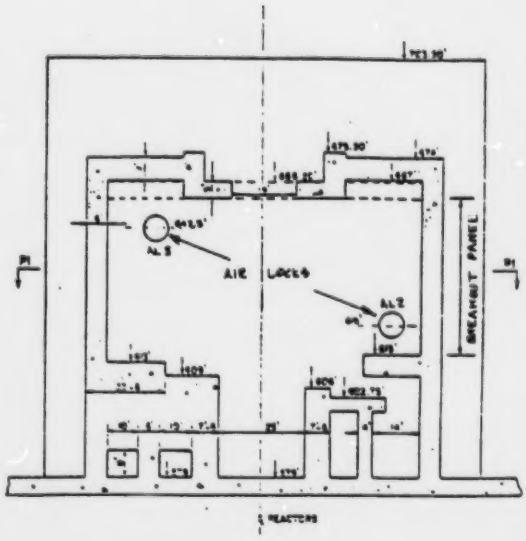
Bruce NGS "B", RB 7
IMPACT HAMMER READINGS

Location	Impact Value	Relative Strength (psi)
Girders		
East girder - east boiler room opposite Boiler 8	51.5	7500
East girder - east boiler room west of Boiler 5	47.3	6800
West girder - west boiler room opposite Boiler 1	52.2	7800
West girder - west boiler room opposite Boiler 4	47.5	6700
Fuelling Machine Duct		
Line 9 between Columns M and N	47.4	6600
Line 9 between Columns N and P	48.1	6800
Line 9 between Columns P and Q	46.4	6500
Line 9 between Columns A and B	48.1	6800
Line 9 west of Column CX	45.7	6300



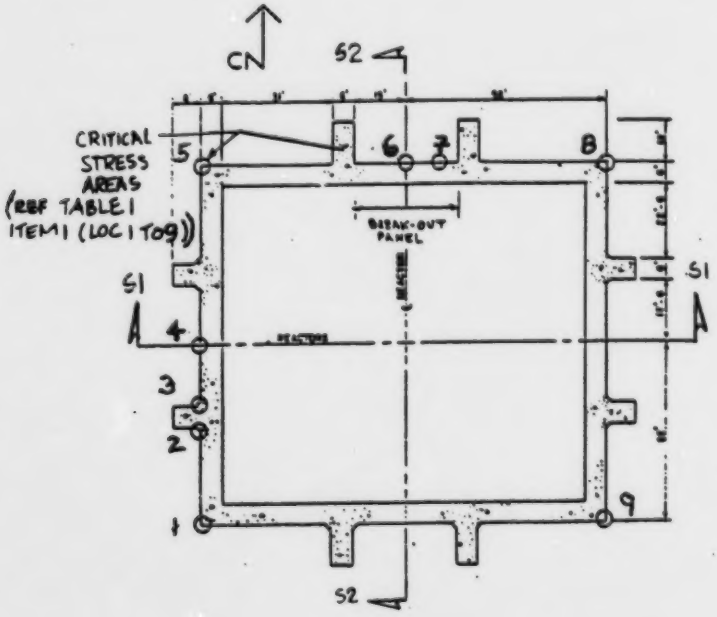
SECTION S1

CRITICAL STRESS AREAS ARE SHOWN BY ○



SECTION S2

CRITICAL STRESS AREAS ARE ABOUND AIR LOCKS



PLAN VIEW
REACTOR BUILDING

CRITICAL STRESS AREAS ARE SHOWN BY ○

FIGURE 1
Bruce NGS "B", RB 7
Inspection Locations

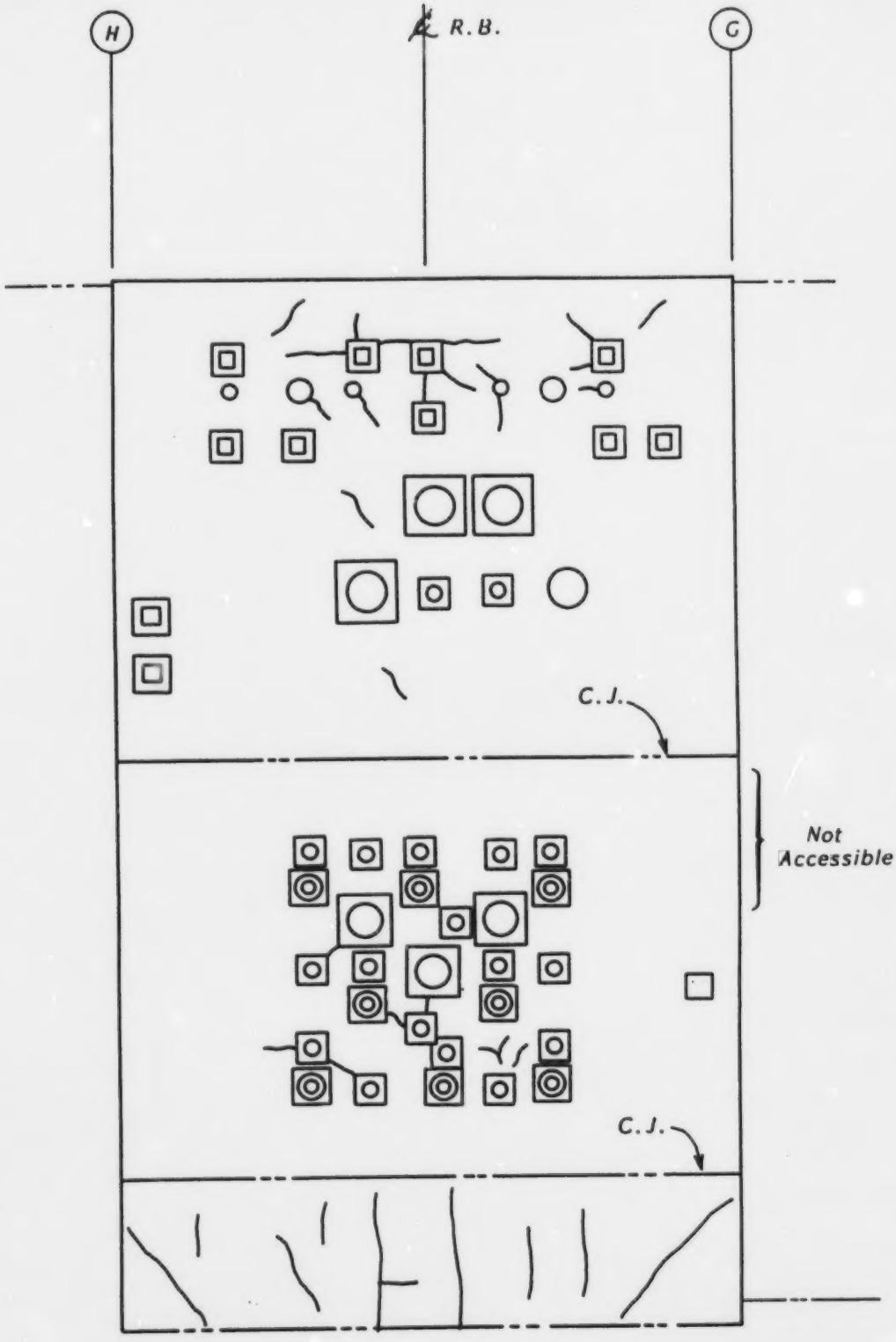


FIGURE 2
Bruce NGS "B", RB 7
Breakout Panel

FIGURE 3 - Typical hairline cracks noted on breakout panel. All crack widths are less than .005 inches.

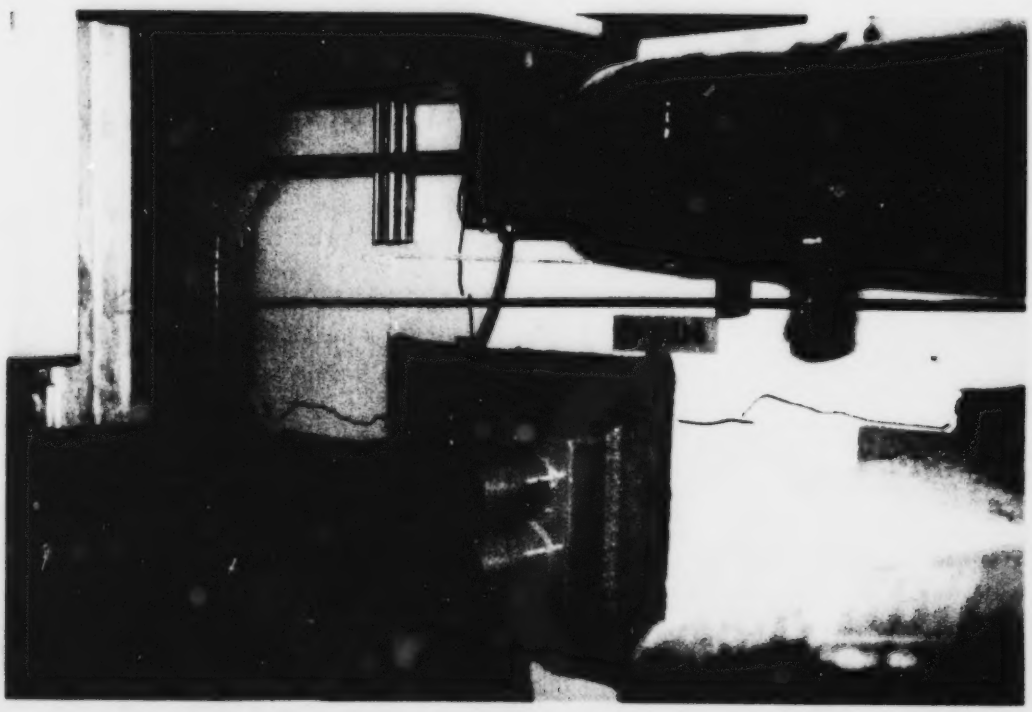


FIGURE 4 - Typical hairline cracks noted on breakout panel. All crack widths are less than .005 inches.

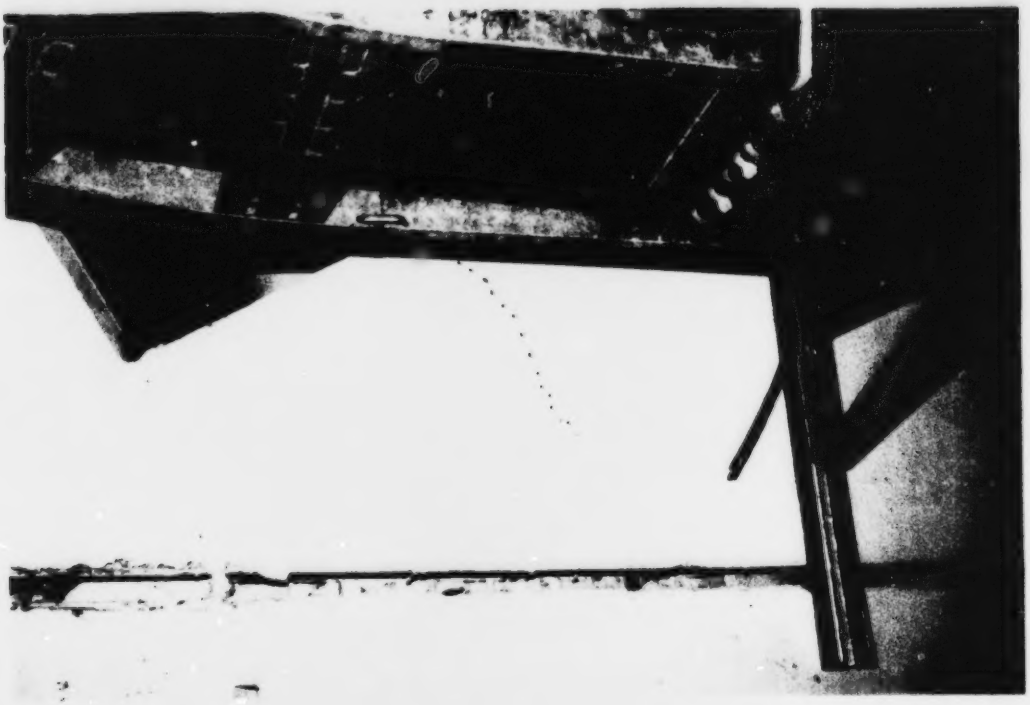


FIGURE 5 - East Girder - south end. Crack marked by dotted line.

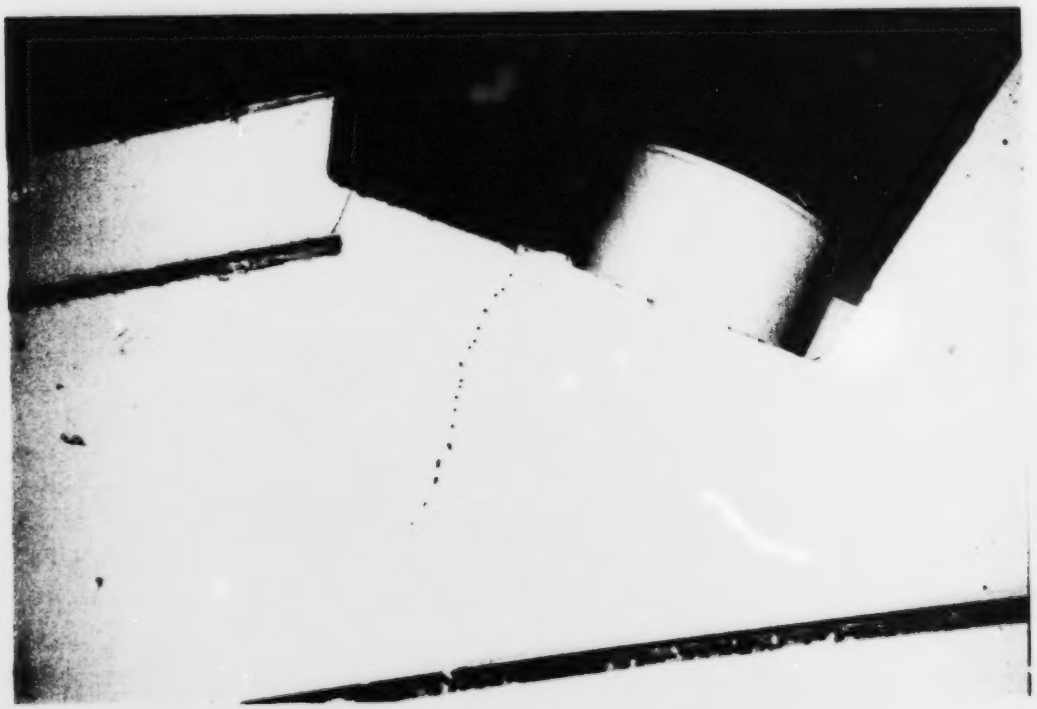


FIGURE 6 - East Girder - north end. Minor hairline crack marked by dotted line.

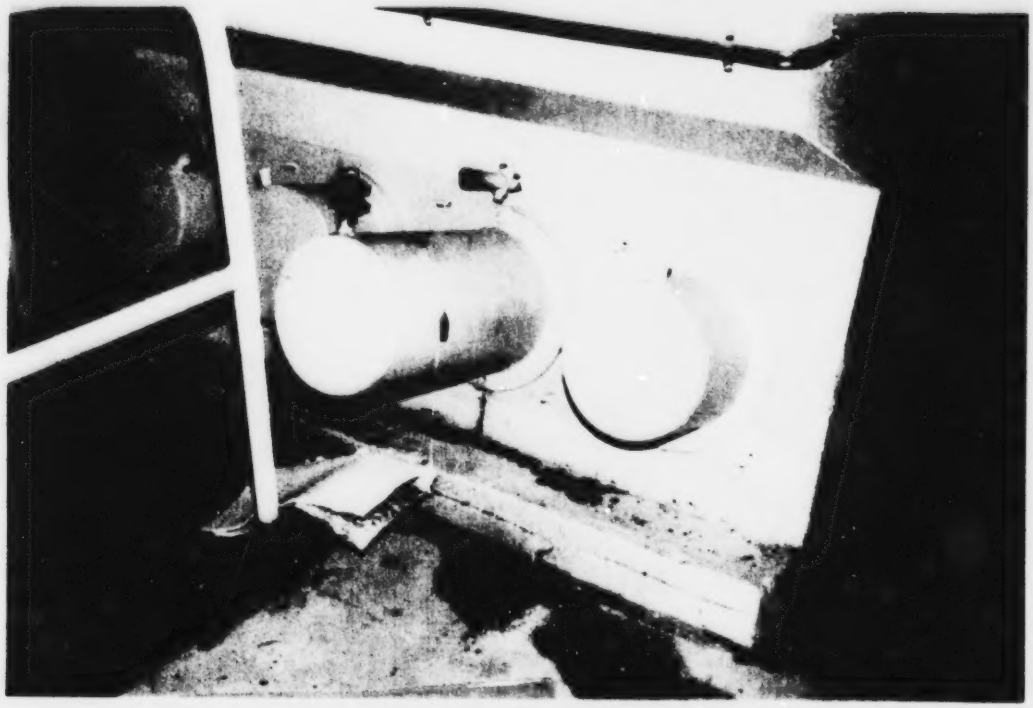


FIGURE 7 - East Girder - north end. Note leakage of grease at anchor cap. Cap not removed since leakage did not appear excessive.

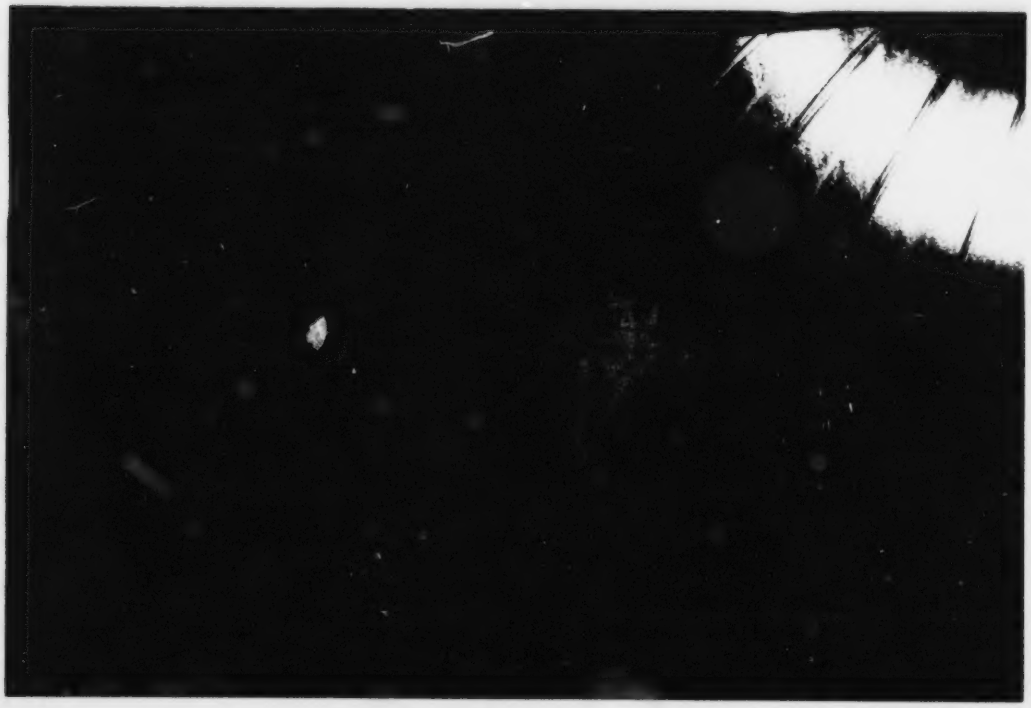
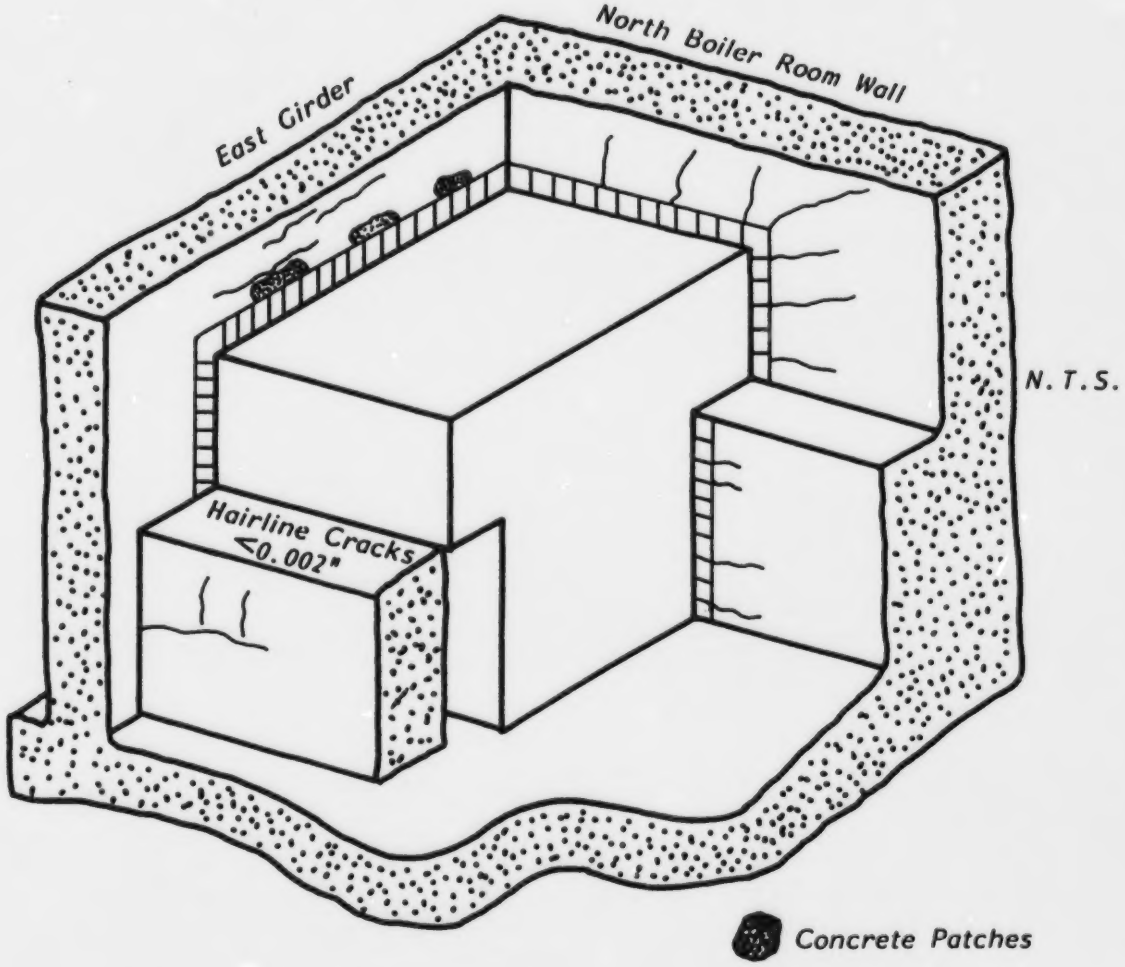


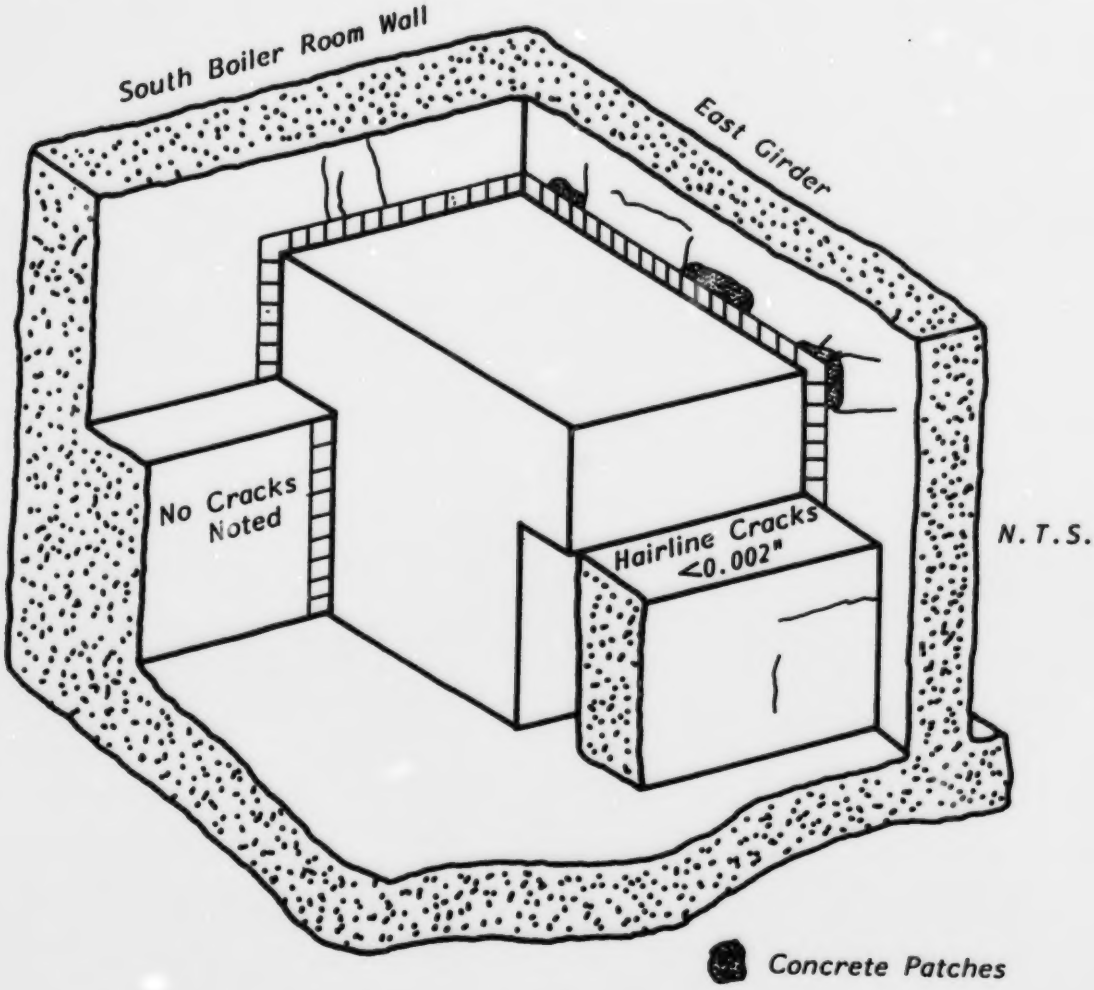
FIGURE 8 - Hairline crack (horizontal) in girder as viewed from the east boiler room above the south preheater enclosure.



General Notes: *Crack width <0.005" unless otherwise noted.*
No signs of concrete deterioration.
Polysulphide sealant between steel enclosure and concrete intact with no signs of deterioration.

FIGURE 9

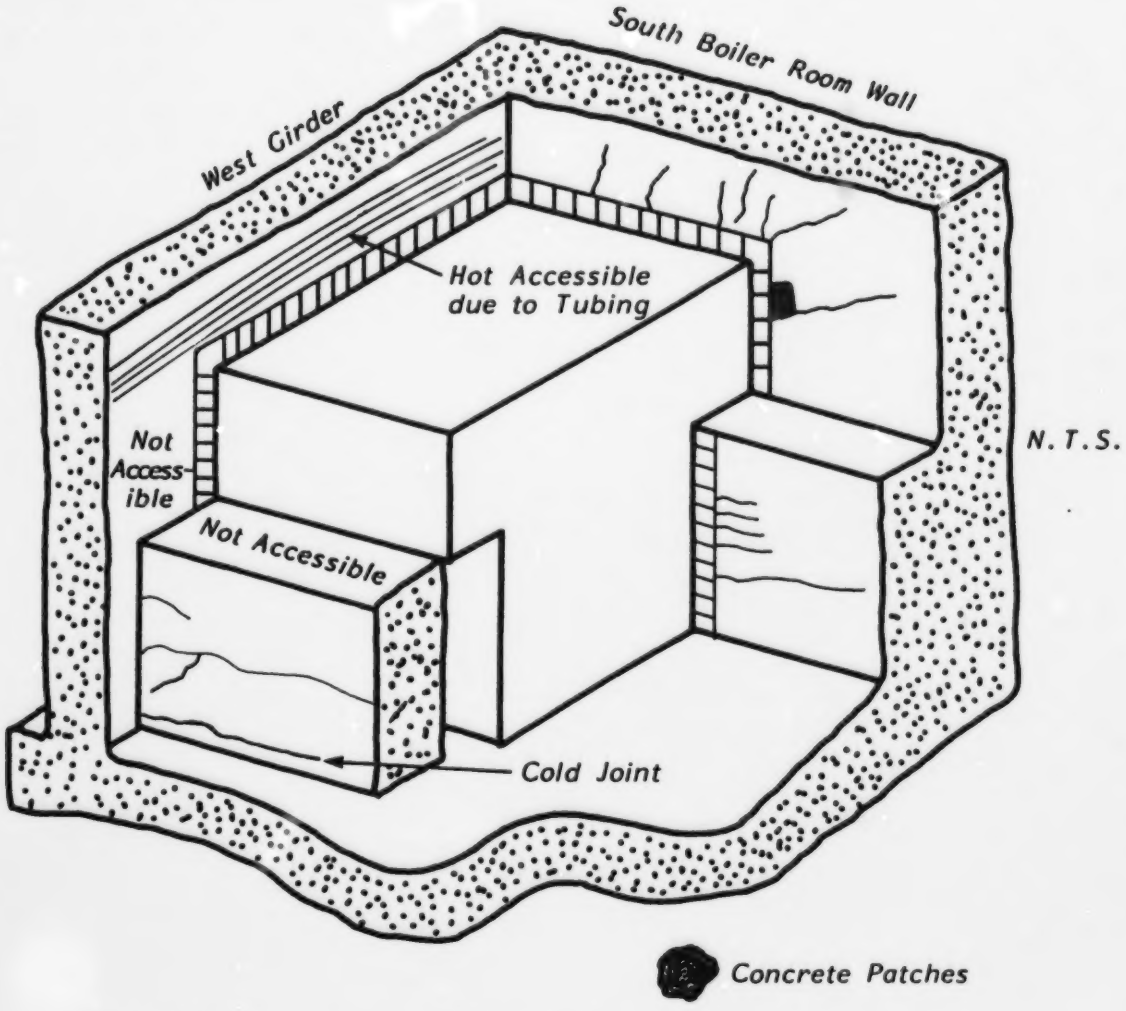
UNIT 7 - NORTHEAST PREHEATER ENCLOSURE CONCRETE INSPECTION



General Notes: *Crack width <0.005" unless otherwise noted. No signs of concrete deterioration. Polysulphide sealant between steel enclosure and concrete intact with no signs of deterioration.*

FIGURE 10

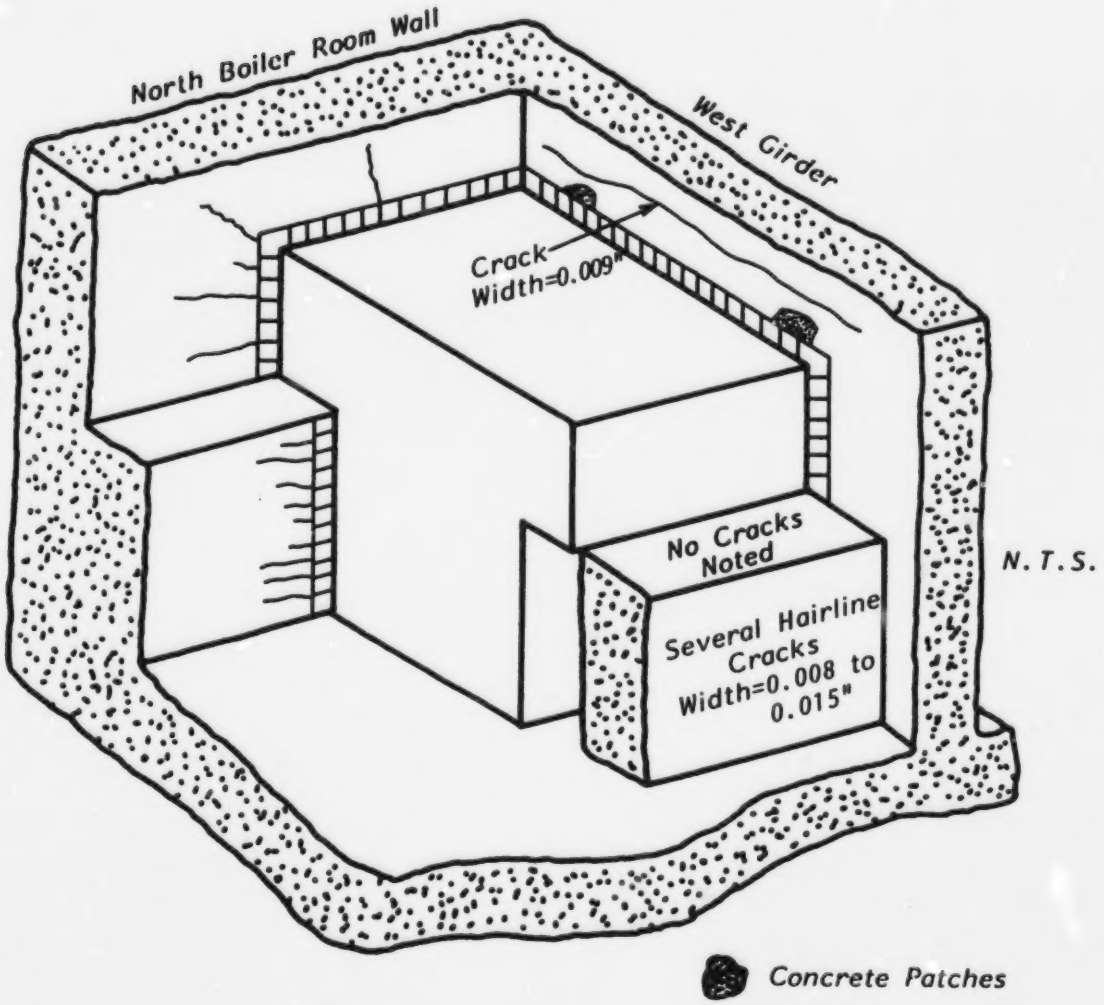
UNIT 7 - SOUTHEAST PREHEATER ENCLOSURE CONCRETE INSPECTION



General Notes: *Crack width <0.005";*
No signs of concrete deterioration.
Polysulphide sealant between steel enclosure and concrete intact with no signs of deterioration.

FIGURE 11

UNIT 7 - SOUTHWEST PREHEATER ENCLOSURE CONCRETE INSPECTION



General Notes: *Crack width <0.005".*
No signs of concrete deterioration.
Polysulphide sealant between steel enclosure and concrete intact with no signs of deterioration.

FIGURE 12
UNIT 7 - NORTHWEST PREHEATER ENCLOSURE CONCRETE INSPECTION

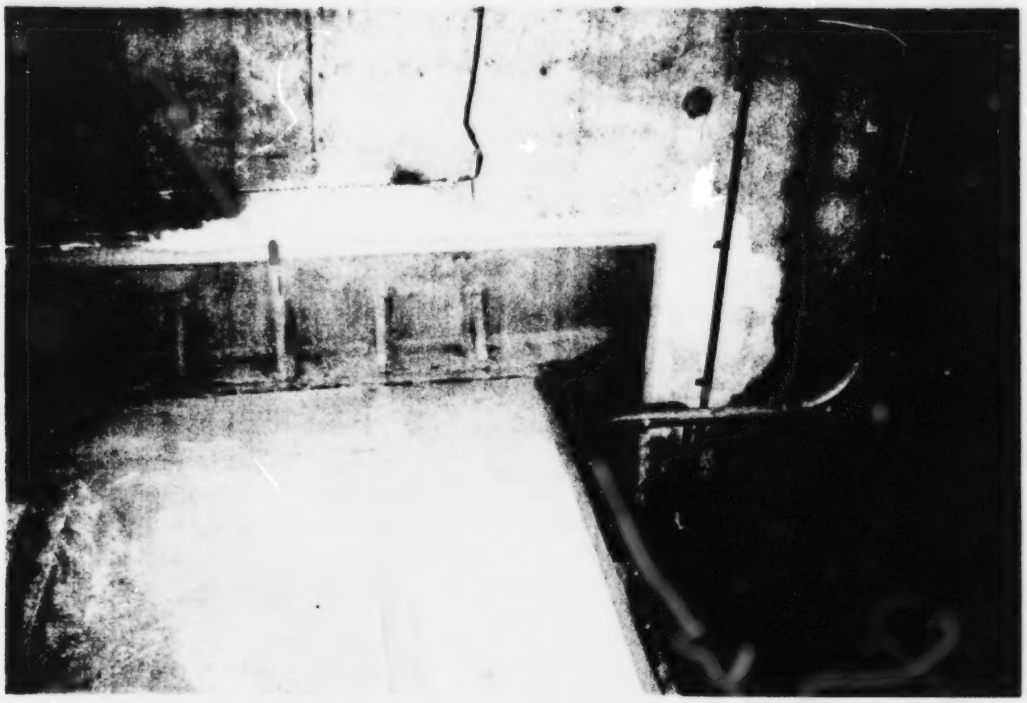


FIGURE 13 - East boiler room. South preheater enclosure showing concrete patch and hairline crack.

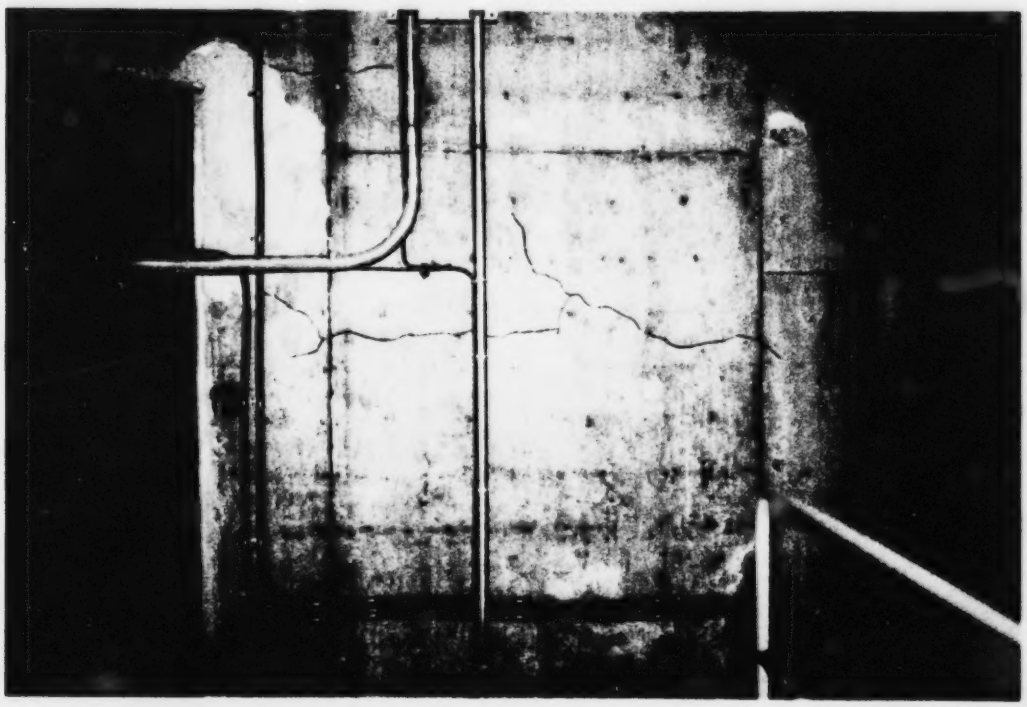


FIGURE 14 - East boiler room. North preheater enclosure showing concrete patch and hairline cracks.

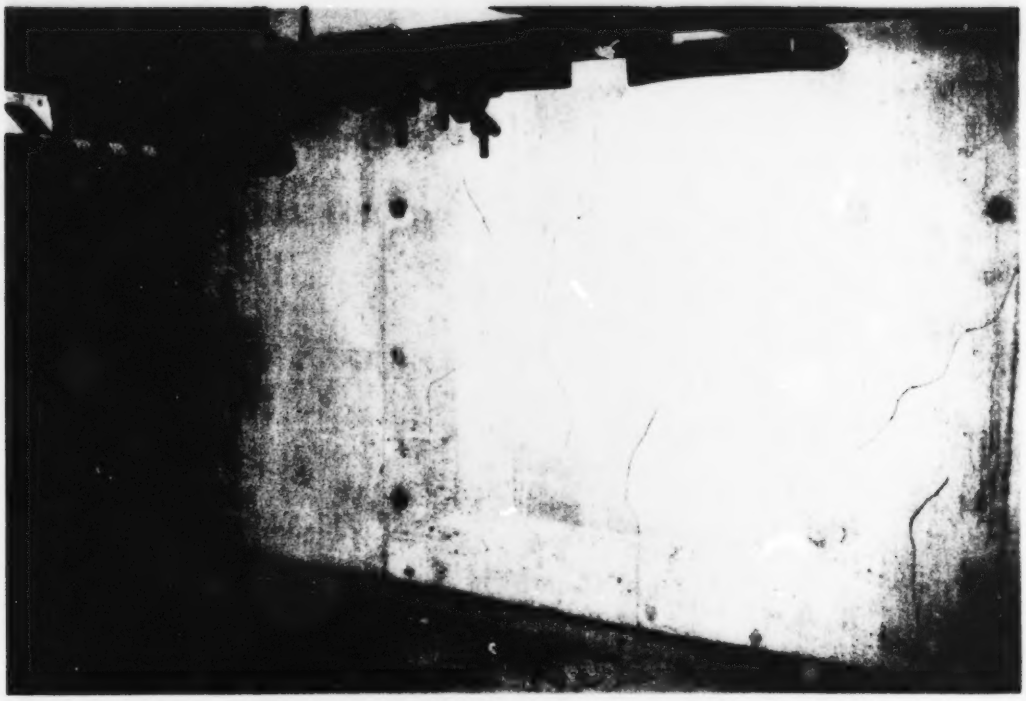


FIGURE 15 - Fuelling Machine Duct. Line 9 between Columns P and Q. Twelve vertical hairline cracks (width <.005 inches) noted in this area.

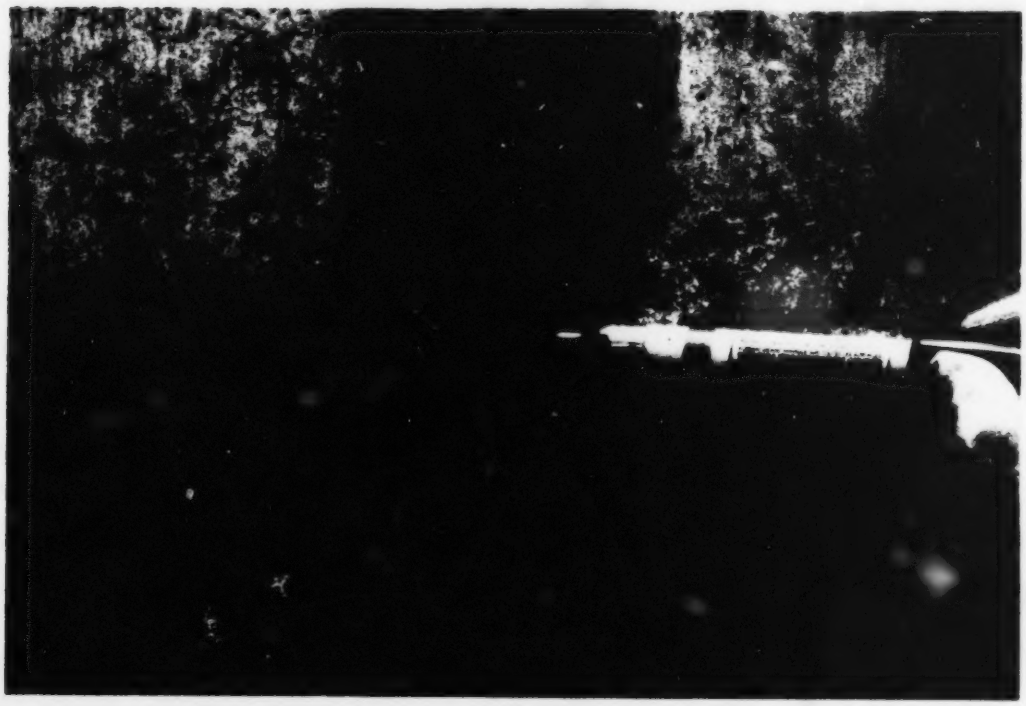


FIGURE 16 - Split section of caulking at joint between Units 0 and 7. Note split.

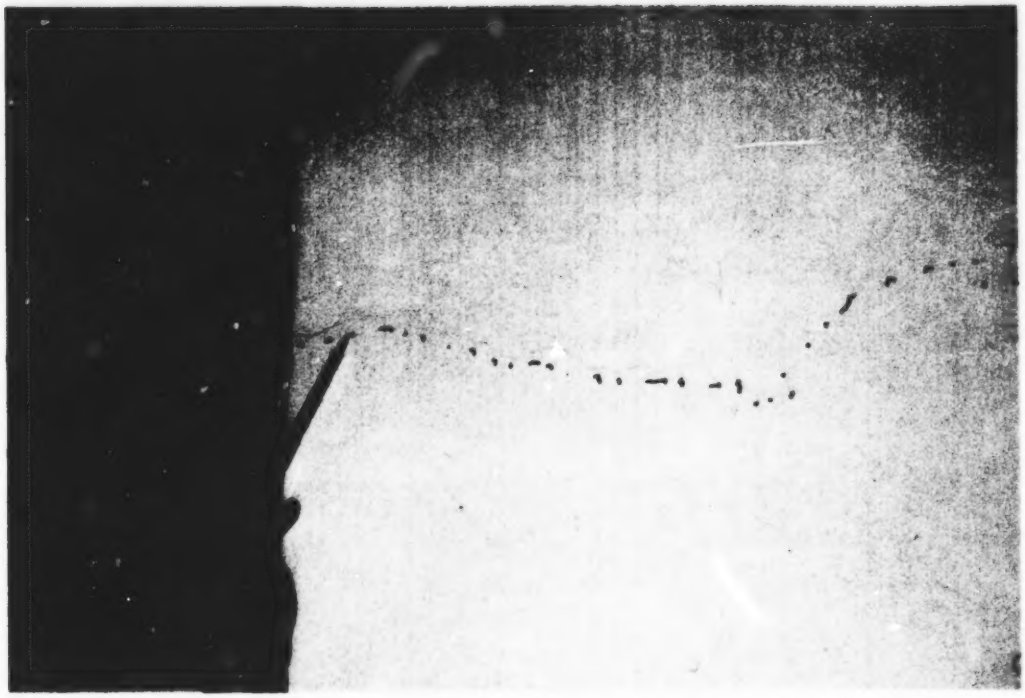


FIGURE 17 - Horizontal hairline crack (width = .020 inches) in south perimeter wall between Columns H and K.

APPENDIX A

BRUCE NGS "B" RB 7

LOCATION OF CRACKS ON REACTOR BUILDING WALLS

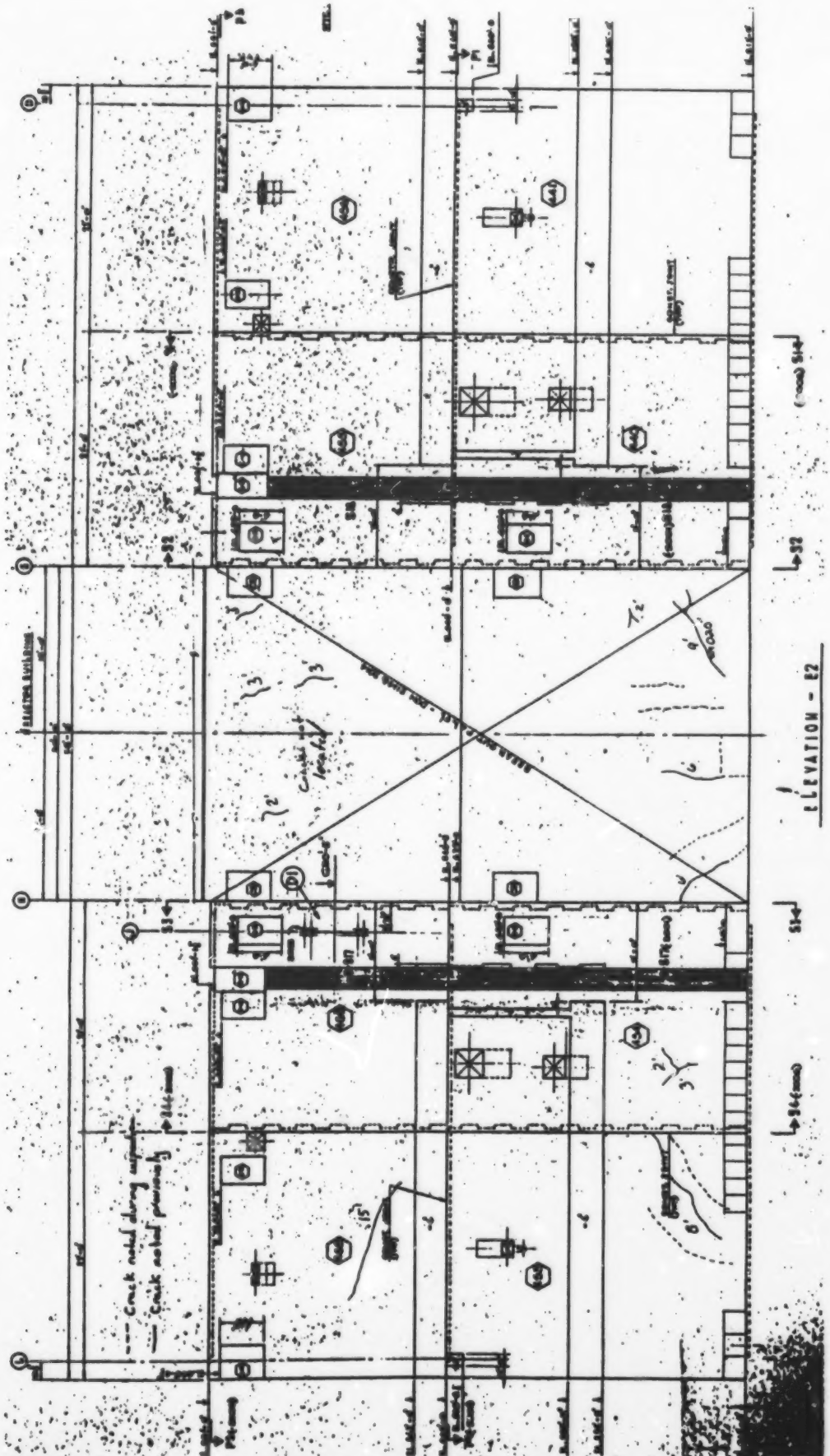


FIGURE A1 - Bruce NGS "B", RB 7 Reactor Building, Exterior North Wall

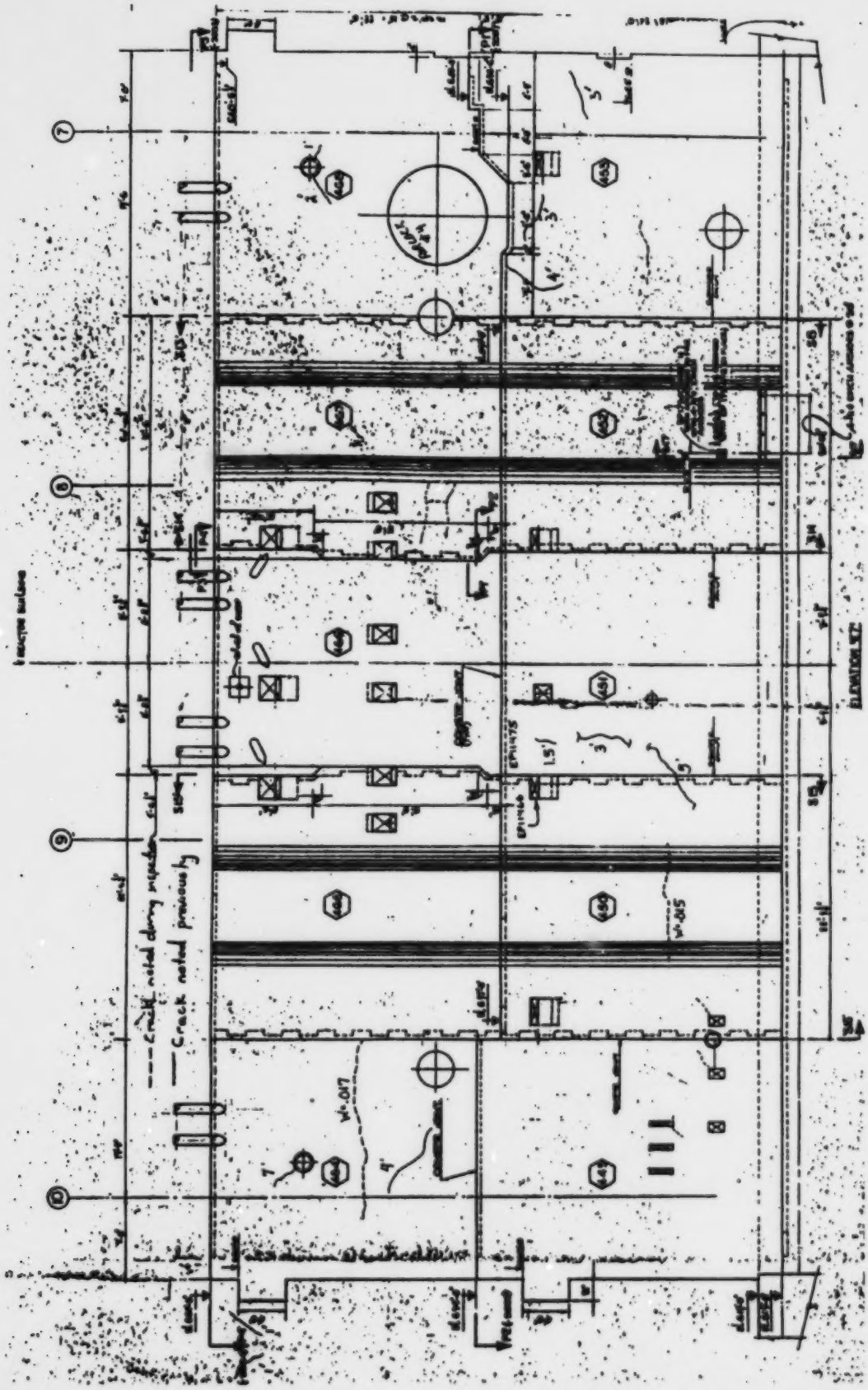


FIGURE A2 - Bruce NGS "B", RB 7 Reactor Building, Exterior East Wall

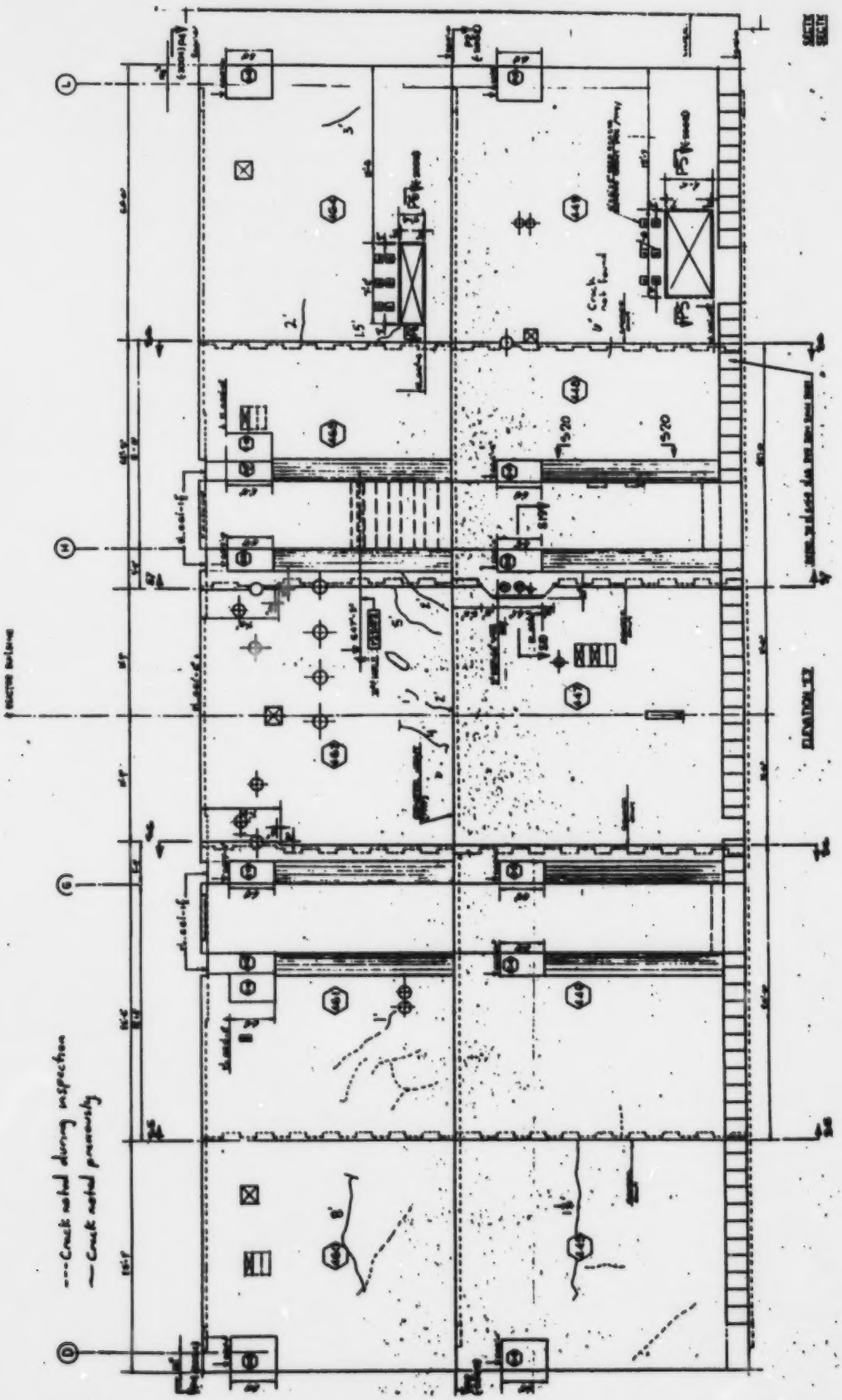


FIGURE A3 - Bruce NGS "B", RB 7 Reactor Building, Exterior South Wall

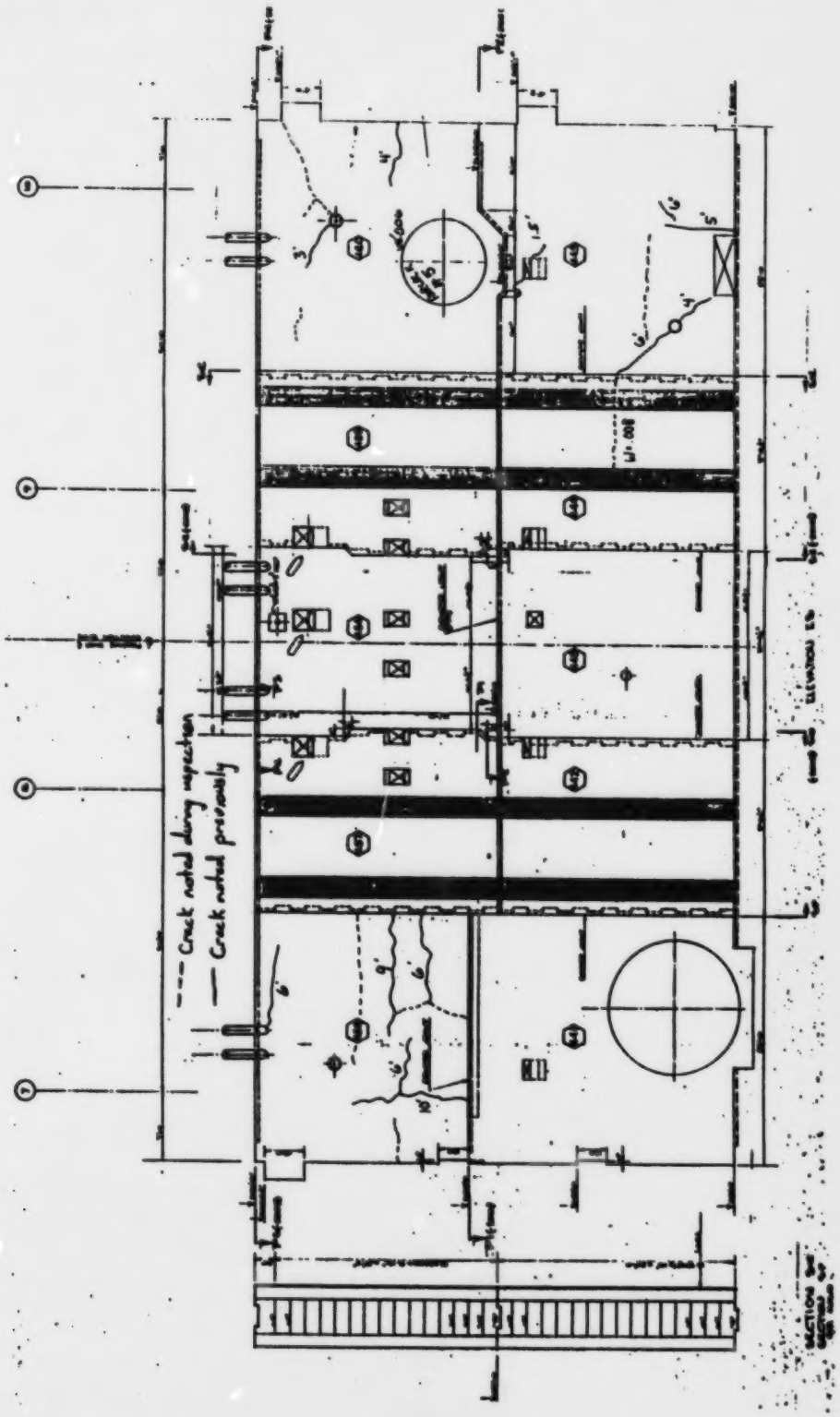


FIGURE A4 - Bruce NGS "B", RB 7 Reactor Building, Exterior West Wall